4,866,614
4,932,414
4,141,347
4,237,901
3,735,755
5,575,853

4,911,170 - high frequency ultrasonic imaging catheter

*5,360,399 *6,167,296

604/96.01

600/452,458

What is claimed is:

1. An apparatus for treating ocular disease comprising: column 7 37-40

a locating means for non-invasively locating Schlemm's Canal in an eye, and

a microsurgical device coupled with the locating means so as to advance the microsurgical device into a tissue space identified with Schlemm's Canal.

~~382/351~~

351/200
↳ eye examining or testing instrument

trigger (10a)

2. The apparatus of claim 1, wherein the microsurgical device is under control by the locating means. - CPU

382/351

3. The apparatus of claim 1, wherein the locating means comprises a device for ultrasound examination of the sclera.

604/22
↳ ultrasound

4. The apparatus of claim 1, wherein the locating means comprises an ultrasound imaging system.

5. The apparatus of claim 1, wherein the locating means comprises a non-imaging ultrasound detection system.

6. The apparatus of claim 1, wherein the locating means comprises an ultrasound device for examination of the sclera with an ultrasound frequency greater than 10 MHz.

3,941,122

7. The apparatus of claim 1, wherein the locating means comprises an ultrasound device for examination of the sclera with an ultrasound frequency of at least 40 MHz.

8. The apparatus of claim 3, wherein the locating means utilizes an ultrasound contrast tracer introduced into the aqueous humor.

6,132,699

9. The apparatus of claim 1, wherein the locating means comprises a non-imaging ultrasound device for examination of the sclera.

10. The apparatus of claim 9, wherein the locating means comprises a transducer assembly with signaling means for directing the transducer location.

11. The apparatus of claim 1, wherein the locating means comprises an optical imaging device for non-invasively locating Schlemm's Canal in the eye.

12. The apparatus of claim 11, wherein the optical imaging device comprises a high intensity white light illumination source.

13. The apparatus of claim 11, wherein the optical imaging device comprises an optically coherent illumination source.

14. The apparatus of claim 11, wherein the optical imaging device comprises a fiber optic device.

15. The apparatus of claim 11, wherein the optical imaging device utilizes detection via visible wavelengths of light.

16. The apparatus of claim 11, wherein the optical imaging device utilizes detection via infrared wavelengths.

17. The apparatus of claim 11, wherein the optical imaging device utilizes optical imaging of a fluorescent tracer in the aqueous humor.

18. The apparatus of claim 1, wherein a tissue contacting surface of the locating means is curved to approximate the surface of the eye.

19. The apparatus of claim 1, wherein a tissue contacting surface of the locating means incorporates a circumferential raised portion to maintain placement of a coupling fluid over a transducer face to aid in energy transfer between the locating means and the tissue surface.

5,984,904 claim 1

20. An apparatus for treating ocular disease comprising:

a non-invasive locating means for locating Schlemm's Canal in the eye, and

a microcannula (109) coupled with the locating means so as to slidably advance into a tissue space identified with Schlemm's Canal.

- divisions

21. The apparatus of claim 20, wherein the microcannula has an outer diameter of less than 200 microns.

22. The apparatus of claim 20, wherein the microcannula is coupled to the locating means at an angle between 0 and 30 degrees from the plane of Schlemm's Canal in the eye.

6,203,499

23. The apparatus of claim 20, wherein an angle of the microcannula with respect to the locating means is adjustable.

24. The apparatus of claim 20, wherein the locating means and the microcannula are disposed within a unitary body. ✓

25. The apparatus of claim 20, wherein the microcannula is coupled to the locating means by way of a clip mechanism.

4,883,053

26. The apparatus of claim 20, wherein a distal portion of the microcannula is curved to accommodate a curvature of Schlemm's Canal.

5,921,954

27. The apparatus of claim 20, wherein the microcannula incorporates a cutting tip to penetrate a sclera of the eye.

5,092,837

5,984,904

28. The apparatus of claim 20, wherein the microcannula is comprised of an outer sheath and an inner cannula.

29. The apparatus of claim 28, wherein the inner cannula incorporates a cutting tip to penetrate a sclera of the eye.

~~30. The apparatus of claim 29, wherein the outer sheath is comprised of a rigid tube.~~

31. The apparatus of claim 29, wherein the outer sheath is comprised of a flexible tube.

32. An apparatus for treating ocular disease comprising:

a non-invasive locating means for locating Schlemm's Canal,

a microcannula which is linked with the locating means to advance the microcannula into an identified tissue space for Schlemm's Canal, and

a dilation mechanism at the tip of the microcannula.

33. The apparatus of claim 32, wherein the dilation mechanism is comprised of an expandable balloon.

34. The apparatus of claim 32, wherein the dilation mechanism is comprised of an expandable tip on the microcannula.

35. The apparatus of ~~claim 32~~, wherein ~~the dilation~~ mechanism is comprised of a ~~series of nested~~ cannulae having successively larger diameters.

36. The apparatus of claim 32, wherein the dilation mechanism is comprised of an elongate rod having steps of successively increasing diameters.

37. The apparatus of claim 32, wherein the microcannula is coupled coaxially with the locating means.

38. An apparatus for treating ocular disease comprising:

a non-invasive locating means for locating Schlemm's Canal,

a microcannula which is linked with the locating means to advance the microcannula into an identified tissue space for Schlemm's Canal, and

an implant which is delivered into Schlemm's Canal .

39. The apparatus of claim 38, wherein the implant comprises an expandable stent. } 5957975

~~40. The apparatus of claim 38, wherein the implant comprises microparticles.~~

~~41. The apparatus of claim 38, wherein the implant comprises a drug releasing material.~~

42. The apparatus of claim 38, wherein the stent comprises a biodegradable material. } 5593403

43. The apparatus of claim ~~40~~, wherein the microparticles comprise a biodegradable material.

44. The apparatus of claim 41, wherein the drug releasing material contains a drug effective in the treatment of glaucoma.

45. An apparatus for treating ocular disease comprising:

a non-invasive locating means for locating Schlemm's Canal,

a microcannula which is linked with the locating means to advance the microcannula into an identified tissue space for Schlemm's Canal, and

a construct which is delivered through the microcannula to effect a surgical procedure on a trabecular meshwork of the eye.

46. The apparatus of claim 45, wherein the construct comprises a surgical tool for cutting tissues.

47. The apparatus of claim 45, wherein the construct comprises a fiber optic device.

48. The apparatus of claim 47, wherein the fiber optic device is an imaging fiber.

49. The apparatus of claim 47, wherein the fiber optic device is an illuminating fiber.

50. A method for surgically accessing Schlemm's Canal for treating ocular disease, comprising:

locating Schlemm's Canal in an eye via non-invasive means;

advancing a minimally invasive surgical device into the canal guided by the locating means;

delivering a substance for the treatment of the ocular disease.

51. The method of claim 50, wherein Schlemm's Canal is located using ultrasound imaging.

52. The method of claim 50, wherein Schlemm's Canal is located using optical means.

53. The method of claim 50, wherein ultrasound imaging is utilized.

54. The method of claim 50, wherein non-imaging ultrasound guidance is utilized.

55. The method of claim 52, wherein high intensity white light is utilized.

56. The method of claim 52, wherein a coherent light source is utilized.

57. The method of claim 52, wherein visible light detection is utilized.

58. The method of claim 52, wherein infrared light detection is utilized.

59. The method of claim 50, wherein the surgical device is a cannula between 50 and 250 microns in diameter.

60. The method of claim 50, wherein the substance is a viscoelastic material.

61. The method of claim 50, wherein the substance is a gas.

62. The method of claim 50, wherein the substance is a fluorocarbon compound.

63. The method of claim 50, wherein the substance comprises a drug releasing substance.